

PAVILLION GAS FIELD

T. K. BJORKLUND¹

INTRODUCTION

The Pavillion Field is located on the western flank of the Wind River Basin about 15 miles northwest of Riverton, Wyoming, on the Wind River Indian Reservation. Gas is produced from multiple, alluvial and possibly transitional-lacustrine sandstone reservoirs in the Wind River Formation (Eocene) and the Upper Fort Union Formation (Paleocene) at depths ranging from 1,500 to 5,000 feet (Fig. 1). Gas accumulations in these reservoirs are localized by stratigraphic variations on the crest and flanks of a broad structural dome (Fig. 2). Only one possible fault on the west flank of the field is suggested by well log correlations, and it does not appear to affect the distribution of hydrocarbons. Non-commercial amounts of gas have been produced from the Frontier Formation (Upper Cretaceous) at a depth of 15,500 feet.

The field is the third largest gas field in the Wind River Basin based on cumulative production (Petroleum Information, Inc., 1977), and was the first field to produce hydrocarbons from reservoirs of Tertiary age. Cumulative production is 71 billion cubic feet of gas. Twenty-four wells are presently producing nearly 30 million cubic feet of gas per day.

EXPLORATION AND DEVELOPMENT

In 1953, Gulf Oil Company drilled Rhodes No. 1 (Sec. 3, T3N, R2E) on the crest of the structure. Total depth was 11,000 feet, penetrating to the basal Mesaverde Formation (Upper Cretaceous). Although gas was reported on a drill-stem test of the Fort Union Formation, the well was plugged and abandoned. The field was discovered 7 years later, in 1960, by Shell Oil, Well No. 14-12 (Sec. 12, T3N, R2E) which was drilled to a total depth of 6,505 feet in the Fort Union Formation. The well was initially completed in the Upper Fort Union Formation in the interval from 3,838 to 3,858 feet for a rate of 1.9 million cubic feet of gas per day. The deepest test in the field is Shell Tribal No. 33X-10, which was drilled to a total depth of 19,235 feet in the Madison Formation (Mississippian). An attempt to complete the well in the Frontier Formation was unsuccessful and the well was finally completed in a basal Wind River sandstone.

ACKNOWLEDGEMENTS

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Development of the gas accumulations in the Wind River Formation and Fort Union Formation on 640-acre spacing was completed in early 1968 with twelve producing wells. One well was subsequently plugged and abandoned in 1969. In 1973 and 1974, six wells were drilled to develop zones not completed in existing wells, resulting in only limited success. Since 1976, production from a previously discovered basal Wind River sandstone has been accelerated with the completion of four wells on the south flank of the field and one well on the northeast. Two Fort Union tests recently extended the productive limits of the field to the northwest. Currently, three companies are conducting operations in the field.

Below the Fort Union Formation, development has been limited to Hickerson Lloyd No. 1 (Sec. 3, T3N, R2E), which was completed for an initial rate of 292 thousand cubic feet of gas and 165 barrels of water per day from the Frontier Formation at a total depth of 15,575 feet in August, 1971. No cumulative gas production from the well has been reported, and the well is currently shut-in.

Gas produced from the Pavillion Field has been purchased by Montana-Dakota Utilities since November 30, 1964. Representative analysis of gas produced from the Wind River Formation and Fort Union Formation are shown in Table 1.

RESERVOIR CHARACTERISTICS

The geometry of sandstone reservoir bodies in the Wind River Formation and Fort Union Formation is not known because of uncertainties of correlation between wells and lack of close-spaced control. Only one sandstone body, a basal sandstone in the Wind River Formation, can be mapped as a discrete unit over a significant area. It contains up to about 50 net feet of gas-productive section on the south flank of the field and pinches out to the north across the crestal portion of the structure. Porous zones in other sandstone units average only about six feet in thickness, but as many as 16 zones may be perforated in a single well (Fig. 3).

Limited data indicate that the sandstone reservoirs in the Pavillion Field are fine to coarse, immature, chert-bearing arkoses, subarkoses and orthoquartzites (Folk, 1961). Kaolinite and montmorillonite clays may constitute up to 15 per cent of the rock volume and significantly reduce porosity. Minor amounts of carbonate cement are also present locally. The average porosity and permeability of the producing zones are estimated at 20 per cent and three millidarcies but probably range as high as 30 per cent and 300 millidarcies. The pressure gradient in the

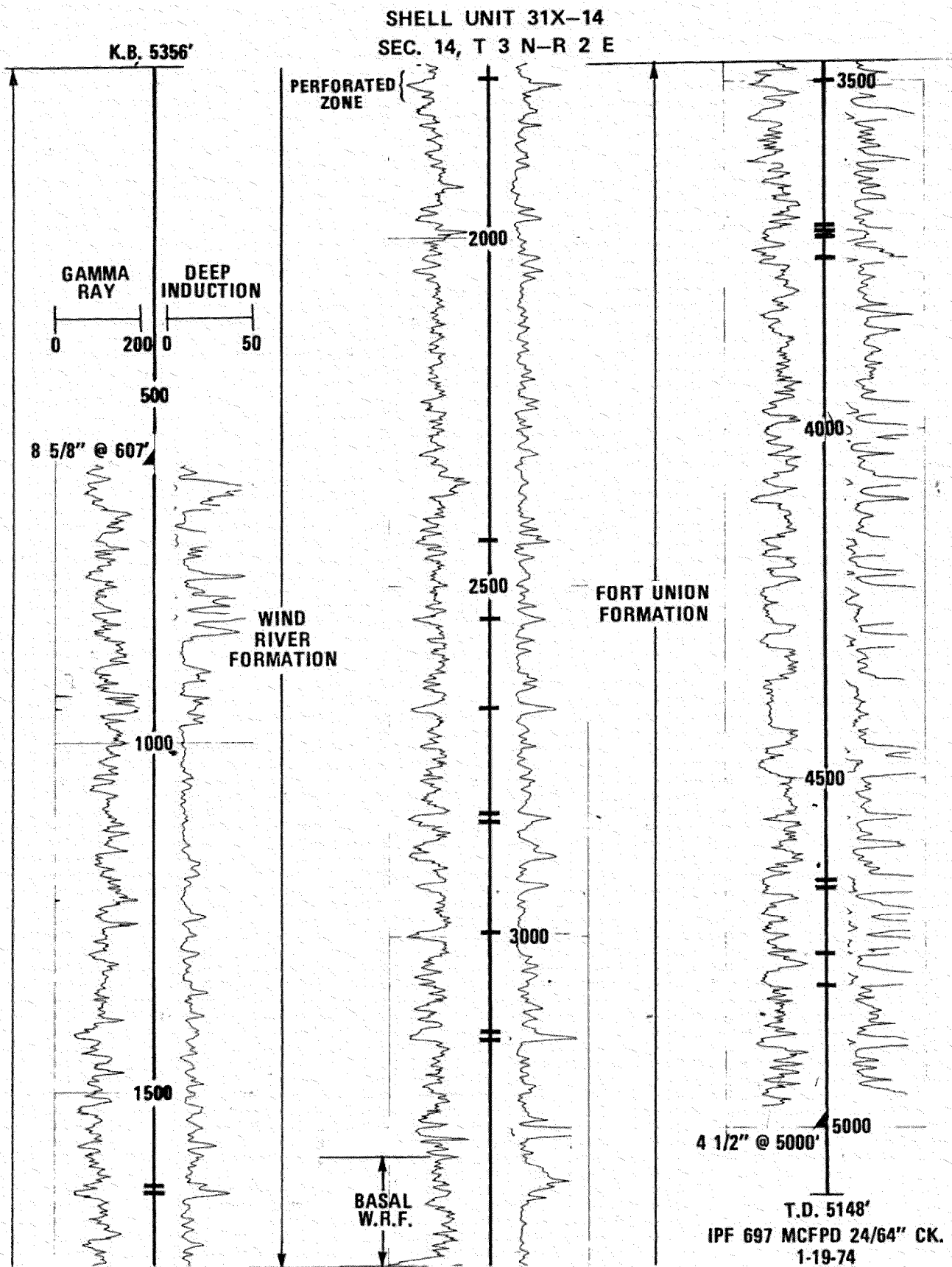


FIGURE 1 - TYPICAL WELL LOG OF PAVILLION FIELD, FREMONT COUNTY, WYOMING

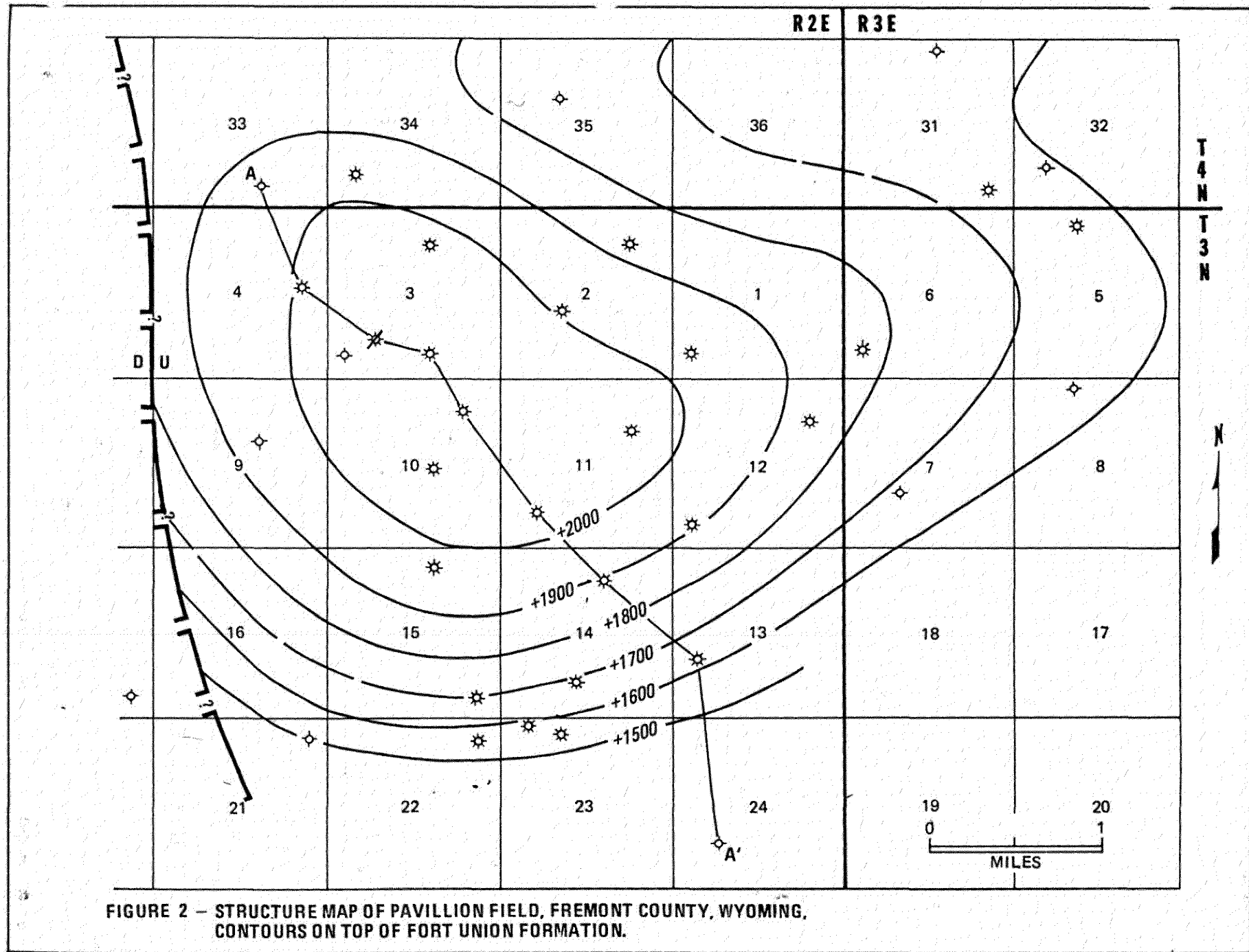


FIGURE 2 - STRUCTURE MAP OF PAVILLION FIELD, FREMONT COUNTY, WYOMING, CONTOURS ON TOP OF FORT UNION FORMATION.

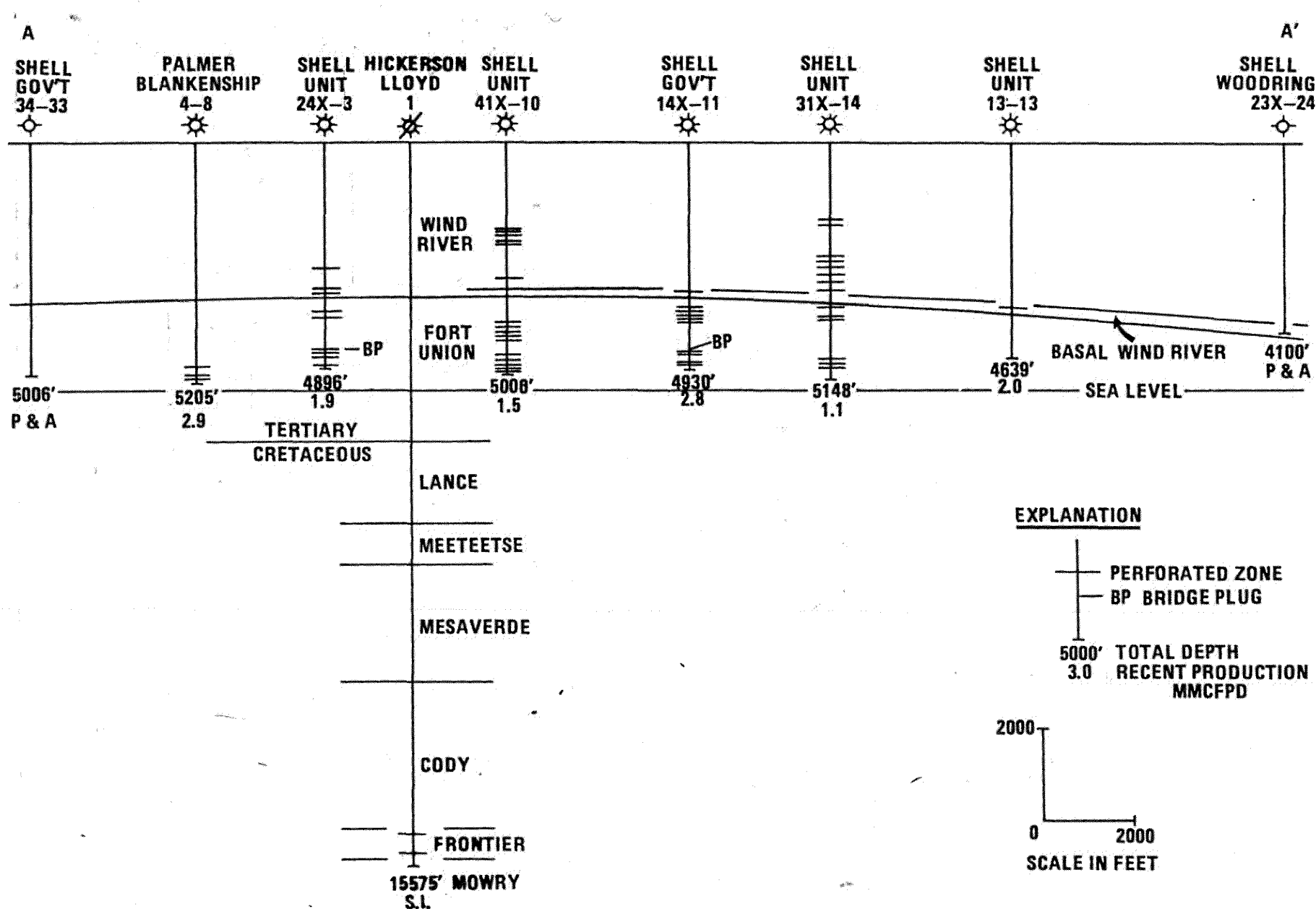


FIGURE 3 - CROSS SECTION A-A' OF PAVILLION FIELD, FREMONT COUNTY, WYOMING

TABLE 1 — Analyses of Gas from Pavillion Field

Well: Shell Tribal 31-15 (Sec. 15, T3N, R2E) Formation: Wind River
Date: September 2, 1976

Component	Mole % Or Volume %	
Oxygen	0.00	
Nitrogen	0.43	
Carbon Dioxide	0.08	
Hydrogen Sulfide	0.00	
Methane	94.98	Gallons
Ethane	3.31	Per MCF
Propane	0.56	0.154
Iso-Butane	0.20	0.065
N-Butane	0.13	0.041
Iso-Pentane	0.07	0.026
N-Pentane	0.04	0.014
Hexanes & Higher	0.20	0.092
TOTAL	100.00	0.392

GPM of Pentane & Higher Fraction	0.132
Gross BTU/CU ft @ 60F & 14.7 PSIA (Dry Basis)	1059.
Specific Gravity (Calculated from Analysis)	0.591
Specific Gravity (Measured)	0.589

H₂S = Negative to Lead Acetate Paper

Well: Shell Government 14-1 (Sec. 1, T3N, R2E)
Formation: Fort Union
Date: September 2, 1976

Component	Mole % Or Volume %	
Oxygen	0.00	
Nitrogen	0.39	
Carbon Dioxide	0.08	
Hydrogen Sulfide	0.00	
Methane	95.75	Gallons
Ethane	3.19	Per MCF
Propane	0.25	0.069
Iso-Butane	0.18	0.059
N-Butane	0.06	0.019
Iso-Pentane	0.05	0.018
N-Pentane	0.02	0.007
Hexanes & Higher	0.03	0.014
TOTAL	100.00	0.186

GPM of Pentane & Higher Fraction	0.039
Gross BTU/CU ft @ 60F & 14.7 PSIA (Dry Basis)	1043.
Specific Gravity (Calculated from Analysis)	0.580
Specific Gravity (Measured)	0.578

H₂S = Negative to Lead Acetate Paper

reservoirs was initially 0.421 pounds per square inch per foot.

FUTURE POTENTIAL

The productive limits of the Wind River Formation and the Upper Fort Union Formation were essentially defined by the initial 640-acre drilling program. Subsequent drilling has largely resulted from changing economic conditions and improved methods of completion. These factors are likely to contribute to future development of the Wind River Formation and Fort Union Formation. This development will probably involve recompletions of existing wells and possibly additional outstep drilling along the margins of the field.

Development of the Frontier Formation does not appear to be warranted on the basis of existing production data, but the Formation may not have been tested in an optimum structural position. Future drilling will depend on better resolution of the deeper structural and stratigraphic relationships.

REFERENCES CITED

- Folk, R. L., 1961, Petrology of Sedimentary Rocks: Austin, Texas, Hemphill's, 154 p.
Petroleum Information, Inc., 1977, Oil and Gas Production report, Wyoming, November, 1977: Denver, Colorado.